A Survey of American Honeys

1583

HONEY IS FIRST and foremost a carbohydrate material. Sugars make up 95-99.9 percent of the solids of honey and their identity has been studied for many years. In our survey of the composition of American honeys we have given a great deal of care and attention to the accurate and precise determination of the amounts of the various sugars in the honey samples.

New Methods for Sugar Analysis

In the past ten years or so a quiet revolution has taken place in the field of analytical chemistry. New materials, new methods and new instruments have brought about better, more rapid and more accurate analyses of many kinds. Analysis of honey sugars is no exception, and methods recently developed

1/ This is one in a series of articles describing a large-scale study of the composition of honeys from over the United States. Complete data interpretation and conclusions will appear in a forthcoming Department of Agriculture publication.

After separation by irrigation, the different sugars in honey are revealed on the chromatographic paper by a color reagent. Results are discussed by J. W. White and Mary Subers. —Courtesy of USDA. Photo by M. C. Audsley.

Number three in a series of ten articles on different honeys of America.

for this purpose in our laboratory were used in our honey composition project. As a result of these improvements we now have new information helping clarify the complex picture of the sugars of honey. This new information is both qualitative - what kinds of sugars are present - and quantitative - measuring the amounts of the sugars.

Kinds of Sugars

Sugars may be grouped according to the size and complexity of their molecules. The groups of interest to us are three. These include the monosaccharides, or simple sugars. These are the individual "building blocks" of the more complex sugars, and are not further broken down without greatly changing their properties. Examples are dextrose and levulose, the predominating sugars in honey. The disaccharide sugars are also of interest to us; they are somewhat more complex than the simple monosaccharide sugars, being each made up of two such units. The kind of sugar and the type of linkage between them can differ, so that hundreds of disaccharides are possible. The best known disaccharides are sucrose (table sugar) and maltose. For our purposes, we consider all other more complex sugars together in one group, the higher sugars. These include trisaccharides, made up of three sugar units (such as melezitose) and even more complex sugars with four or more monosaccharide units. As the complexity of these saccharides increases they approach the structure of dextrins and starches.

Sugars Found in Honey

Honey was long thought to be mainly levulose and dextrose, with some sucrose and dextrins. These were considered to be poorly-defined complex sugars of high molecular weight.

With the advent of new methods for analyzing and separating sugars, workers in Europe, in this country and in Japan have found many sugars in honey and in some cases isolated and identified them by suitable physical and chemical methods.

The table shows the names of the sugars and gives some other information about them. Many of these have

Table 1. Sugars Identified in Honey

Name	Investigators
Monosaccharides	
Levulose	Long known to occur
Dextrose	
Disaccharides	
Sucrose	Long known to occur
Maltose	White and Hoban a/
Isomaltose	Watanabe and Aso b/; White and Hoban
Turanose	White and Hoban
Maltulose	White and Hoban
Nigerose	White and Hoban
Kojibiose	Watanabe and Aso
Higher Sugars	
Melezitose	Reported by Goldschmidt and Burkert c/ but not isolated or adequately identified.
Erlose	
Kestose	
Raffinose	
Dextrantriose	

a/ Arch. Biochem. Biophys. 80, 386 (1959).
b/ Nature 183, 1740 (1959)
c/ Z. Physiol. Chem. 300, 188 (1955).

As a check on the sugar analyses, Mary Subers places paper chromatograms in the cabinet for solvent irrigation.—Courtesy USDA. Photo by M. C. Audsley.

been considered very rare; some have never been found in a natural product before, though made in the laboratory.

Most of these sugars probably do not occur in nectar, but arise due to either enzymic action during the ripening of honey or by chemical action in the concentrated, somewhat acid sugar mixture we know as honey, during storage.

Sugars in Various Types of Honey

One of the questions we were concerned with in our analytical survey of American honeys was whether all honey contained the same sugars, especially the minor sugars, or if possibly certain types of honey would have different kinds of sugars. To check this, we examined all sugar solutions we analyzed from all samples by the process of paper chromatography. This is a way to separate the individual sugars from each other and to spread them out on paper so they could be counted and compared. In all of the honey samples we analyzed, the same patterns of sugars were found. There were often differences in the relative amounts of the various sugars, but all honeys appeared to have all of the sugars. This chromatographic check on the solutions we analyzed served also to assure us that our preliminary treatments of the samples were operating properly.

(Next month:- Effect of crop year on composition.)